RESEARCH HIGHLIGHT

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Development and Publication of Training Materials to Support the Implementation of Rainwater Harvesting in Canada

INTRODUCTION

An important element of improving the environmental sustainability of Canada's housing is reduction of household water use through water efficiency and conservation. One means of reducing household water use is to supplement traditional water supplies with rainwater harvested from roofs using rainwater harvesting (RWH) systems. This ancient source of domestic water is currently undergoing a modern-day revival, with RWH systems being installed in a number of "green home" pilot projects across Canada, including some of those constructed under CMHC's EQuilibrium™ Sustainable Housing Demonstration Initiative.

To gain a better understanding of the benefits of RWH to Canadian homeowners, CMHC has led a series of initiatives and research projects on this topic. Early research supported by CMHC revealed that, while RWH was common in some international jurisdictions, the use of such systems was rare (or even prohibited) in many parts of North America.[1] In response to these findings, CMHC worked with the School of Engineering at the University of Guelph along with a number of other organizations to conduct an in-depth study on the feasibility of RWH in Canada. This three-year study determined that, while RWH is feasible, several barriers existed that impeded the wide-scale implementation of RWH in Canada.[2] One such barrier was the lack of knowledge by practitioners and regulators on how to design, install and manage these systems, specifically with regard to the existing codes, standards and guidelines (that is, the "regulatory framework") applicable to RWH systems.

This *Research Highlight* provides an overview of the work that was supported by CMHC and its partners to address this barrier to the wide-scale adoption of rainwater harvesting. This work involved a review of the regulatory framework for RWH, followed by the development of the *Guidelines for Residential Rainwater Harvesting Systems* and the *Fundamentals of Residential Rainwater Harvesting Systems Training Workshop*.

DEVELOPMENT OF TRAINING MATERIALS

To support the implementation of rainwater harvesting in Canada through the development and release of training materials, a multi-stakeholder project was launched by CMHC and the School of Engineering at the University of Guelph, Alberta Municipal Affairs, the Ontario Ministry of Municipal Affairs and Housing, the Canadian Water and Wastewater Association, the City of Calgary, the City of Guelph and the Region of Durham. These organizations formed a stakeholder group that contributed to the development and expert review of the training materials.

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[1] Rainwater Harvesting and Grey Water Reuse. 2003. Canada Mortgage and Housing Corporation. https://www03.cmhc-schl.gc.ca/catalog/productDetail.cfm?cat=37&itm=3&lang=en&fr=1304701204626

[2] Evaluating the Feasibility and Developing Design Requirements and Tools for Large-Scale Rainwater Harvesting in Ontario. 2008. Canada Mortgage and Housing Corporation. https://www03.cmhc-schl.gc.ca/catalog/productDetail.cfm?cat=151&itm=19&lang=en&fr=1304701939718

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Prior to developing the training materials, research was conducted to understand how the regulatory framework in Canada applied to RWH systems. The federal government supports the development of the model National Building Code and model National Plumbing Code. In some cases, provinces and territories either partially or wholly adopt these model codes in their jurisdictions. Alternatively, they can choose to have their own code and seek to harmonize as much as possible with the model codes and the codes of other provinces and territories. Thus, the regulations—the codes, standards and guidelines—that apply to the design, installation and management of RWH systems can vary based on the particular province or territory.

The document that was produced from this research, the *Guidelines for Residential Rainwater Harvesting Systems*, references the model national codes as well as other national standards organizations such as the Canadian Standards Association (CSA). As such, the *Guidelines* document is primarily aimed at the large majority of provinces and territories that adopt the model national codes within their jurisdiction. Given that this may not be the case for all provinces and territories, the *Guidelines* document was specially formatted so that it could be easily amended to reflect the applicable codes, standards and guidelines applicable within a particular jurisdiction. In addition to the *Guidelines*, supplementary versions of the guidelines were developed for the provinces of Alberta and Ontario, to reflect the regulatory framework within each of these provinces.

The *Fundamentals of Residential Rainwater Harvesting Systems Training Workshop* was developed using a similar approach—a national version of the course was developed, but the course was structured so that it could be tailored to reference the regulations applicable to RWH systems in any given jurisdiction. The flexibility of both the *Guidelines* and the *Training Workshop* to incorporate amendments is intended to facilitate the adoption of these training materials in a variety of Canadian jurisdictions as well as simplify the process of updating these resources as regulations change over time.

GUIDELINES FOR RESIDENTIAL RAINWATER HARVESTING SYSTEMS

One of the two training materials developed through this project was the *Guidelines for Residential Rainwater Harvesting Systems*. The *Guidelines* document is a comprehensive technical manual that references the codes, standards and guidelines applicable to RWH systems and provides guidance for the design, installation and management of these systems. The purpose of the *Guidelines* is to address uncertainty and inexperience of practitioners and regulators regarding the design, installation and maintenance of RWH systems.

The *Guidelines* are aimed at a wide audience. To accommodate both those who have and those who do not have experience with RWH, two versions of the document were produced: a "Guidelines" version and a "Handbook" version. The Guidelines document is aimed at individuals with knowledge of the building sector and the basic trades involved in rainwater harvesting (namely, plumbing, electrical and site service work). The Handbook is intended for audiences less familiar with these trades and, as such, includes additional background information on the various aspects of rainwater harvesting systems. Aside from these differences, all other aspects of the documents remain the same. Both reference the same regulatory requirements and specify the same design, installation and maintenance guidelines.

The *Guidelines* document comprises several sections, each of which is organized around a particular component or topic pertaining to RWH systems. The topics addressed by the *Guidelines for Residential Rainwater Harvesting Systems* include:

1. Rainwater Catchment & Conveyance
2. Rainwater Storage & Tank Sizing
3. Rainwater Quality & Treatment
4. Water Make-up System & Backflow Prevention
5. Pump & Pressurized Distribution System
6. Overflow Provisions & Stormwater Management

For each of these topics within the *Guidelines*, a brief introduction/overview is provided, followed by a comprehensive "codes table" that lists the specific codes, standards and guidelines that apply to that topic, with the design, installation and maintenance guidelines presented last. In addition to the codes table and guidelines, the document includes an extensive appendix that contains reference materials and detailed examples of how to design and install various components of a rainwater harvesting system. An example of one of the reference tables provided in the *Guidelines* is shown in Table 1.

Residents of British Columbia can use the figures provided in Table 1 to assist in the sizing of a rainwater storage tank. For a particular site, an optimum size of rainwater storage tank can be selected by using the roof catchment area of the building and the anticipated daily rainwater demand. The tank sizes listed in the table were generated by the *Rainwater*

Harvesting Design Tool, rainwater modelling software that was first developed under CMHC's three-year RWH feasibility study.[3] In addition to this table, the *Guidelines* document contains similar rainwater storage tank sizing tables for other provinces and regions in Canada.

FUNDAMENTALS OF RAINWATER HARVESTING TRAINING WORKSHOP

To complement the *Guidelines* and provide another avenue to educate practitioners, regulatory officials and other stakeholders on the regulatory and technical aspects of RWH systems, a *Fundamentals of Rainwater Harvesting Training Workshop* was also developed. Like the Guidelines, the course is aimed at a wide audience, including engineers, architects, contractors, municipal staff, and members from industry. The workshop comprises two parts, a regulatory component providing an overview of the regulatory framework pertaining to RWH, and a technical component that discusses the technical aspects of designing, installing and managing RWH systems. The workshop is formatted as a one-day course that includes instructor-led discussions and group exercises, both of which reference the *Guidelines for Residential Rainwater Harvesting Systems.*

To ensure that the *Training Workshop* met the needs of its target audience, it underwent a rigorous review and comment process and included the delivery of two pilot workshops. The pilots, one held in Edmonton, Alberta, and the other in Toronto, Ontario, included participants from the project's stakeholder group, along with other experts and other parties interested in RWH. At the pilot sessions, workshop participants provided feedback on the workshop via an open discussion and by feedback forms. This feedback was subsequently used to make a variety of changes and improvements to the *Training Workshop*. Following delivery of these pilots, there has been interest among a number of organizations, including some of the project partners, in delivering the workshop in their jurisdictions.

CONCLUSION

The training materials provide a comprehensive overview of the applicable codes, standards and guidelines that apply to RWH systems and provide comprehensive technical guidance and best practices for the design, installation and management of RWH systems based on international, national and local experience.

Both the *Guidelines* and the *Training Workshop* have generated interest and support among a variety of stakeholders, including conservation authorities, members from the irrigation industry, community environmental groups, and many others. These materials can be adapted to a variety of jurisdictions in Canada.

Table 1 Rainwater storage tank sizing guidelines for British Columbia

Rainwater Demand (Litres per day)	Optimum Rainwater Cistern Capacity (L)											
	Roof Catchment Area (m^2)											
	50	100	150	200	250	300	350	400	450	500	600	700
50	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
100	4,000	4,000	4,000	4,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000
150	4,000	5,000	5,000	5,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000	4,000
200	4,000	5,000	7,500	7,500	5,000	5,000	5,000	5,000	5,000	4,000	4,000	4,000
250	4,000	5,000	7,500	7,500	7,500	7,500	7,500	5,000	5,000	5,000	5,000	5,000
300	4,000	5,000	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500	7,500

[3] Evaluating the Feasibility and Developing Design Requirements and Tools for Large-Scale Rainwater Harvesting in Ontario. 2008. Canada Mortgage and Housing Corporation.

https://www03.cmhc-schl.gc.ca/catalog/productDetail.cfm?cat=151&itm=19&lang=en&fr=1304701939718

IMPLICATIONS FOR THE HOUSING INDUSTRY

The development of residential rainwater harvesting guidelines supports a water-conserving approach that will help improve the overall sustainability of housing and communities. The availability of guidelines helps to ensure a consistent, national approach to the design, installation, performance and management of rainwater harvesting systems. This, in turn, supports the development of industry capacity to deliver effective rainwater systems, regulatory system awareness and knowledge of rainwater harvesting technologies and consumer acceptance of these systems. The guidelines also provide industry with a means to ensure that consumer health and safety issues have been considered and addressed. Though the requirements for the design and construction of rainwater harvesting systems resides with the building authority having jurisdiction in any given area, the development of these guidelines will serve to promote a common approach to rainwater harvesting systems, which can help facilitate more widespread acceptance and uptake of this technology.

For further information and to download the guidelines:

Guidelines for Residential Rainwater Harvesting Systems:
http://www.cmhc.ca/od/?pid=67608

Ontario Guidelines for Residential Rainwater Harvesting Systems:
http://www.sustainabletechnologies.ca/portal/alias__Rainbow/lang__en/tabID__432/DesktopDefault.aspx

Alberta Guidelines for Residential Rainwater Harvesting Systems:
http://www.municipalaffairs.alberta.ca/CP_RainwaterHarvesting.cfm

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Housing Research at CMHC

Under Part IX of the ***National Housing Act***, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

This Research Highlight is one of a series intended to inform you of the nature and scope of CMHC's research.

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